

ERGONOMICS AS INSTRUMENT FOR PREVENTION AGAINST WORK INJURY OR OCCUPATIONAL DISEASES

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Review article

Abstract: Ergonomics as complex branch solves work of employee on concrete work place and follows up relationships between human, machine and work environment. Goal of ergonomics is achievement the most appropriate work environment and decreasing of work injuries and occupational diseases probability. This goal will be achievement by implementation of two instruments - process approach which is built on systematic approach and synergy effect of two basic principles technical and human which affect and affect and complement each other. A powerful tool for decreasing of work injuries and occupational diseases probability can be obtained with combination of process approach and synergy effect.

Keywords: Ergonomics; prevention; psychology; injury; diseases.

Introduction

Sufficiency or rather deficiency in employees with qualification is mentioned more often in current labour market in many regions of the Czech Republic. The root cause can be found in unsuitable setting up of educational system, in direction and structure of employers' needs but also in complex arrangement of occupational health and safety.

It is quite obvious that the loss of a qualified employee due to a work injury or an occupational disease is therefore unacceptable for the employer.

Some employers perceive health and safety at work only from the point of view of complying with legislation or implementing measures (e.g. by covering a rotating part of the machine, using the LOTO system, assigning a PPE, etc.). This approach will only provide basic safety and health protection at work and will reduce the likelihood of losing a skilled workforce.

We need to think more deeply about access to health and safety at work and make the reduction of the work injury or occupational disease (next prevention) more effective as direction against loss of qualified employee.

Focusing on prevention as a process of work conditions improvement is one of possibilities to do it.

This process is inseparable part of multidisciplinary science branch - Ergonomics.

Method of synergic effect can be used as next possibility for prevention. This method is based on interconnection of two main ergonomic principles - technical (safety) and human (health). These principles interact and complement each other.

Strong instrument for prevention can be found by connection of a process approach and a method of synergic effect to decrease probability of work injury or eliminate of occupational diseases.

Materials and methods

Ergonomics as system

Ergonomics can be defined as multidisciplinary science branch, which solves work activities of employee on concrete work place. It focuses on study of relationships between human, machine and work environment, which interact and complement each other (Marek and Skřehot, 2009).

Ergonomics is specific system, which includes free subsystems (human, machine and work environment), Fig. 1.

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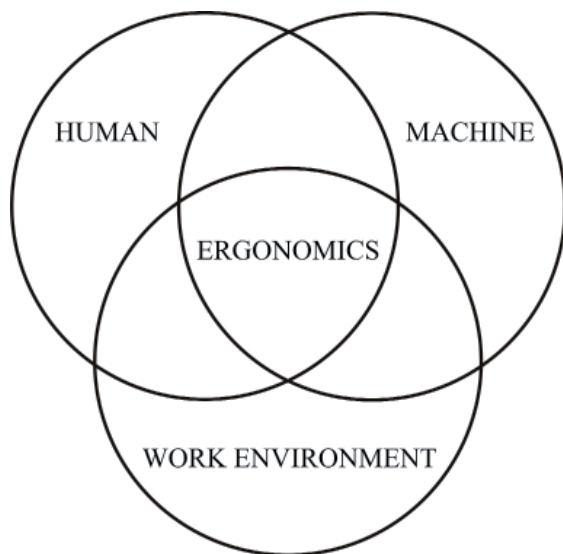


Fig. 1. Illustration of Ergonomics system and subsystems - human, machine, work environment

Process approach

The goal of ergonomics is optimization of particular subsystems interaction in order to achieve the most appropriate working conditions for employees.

This goal can be reached by implementation of process where systematic approach is basis - focusing on ergonomics like on system in which subsystems are interacting and complementing each other.

Process can be divided into 5 steps:

- identification of danger and risk assessment of work positions;
- setting up instrument leading to decrease of risk;
- creation of concept for improvement;
- testing of proposed countermeasures and verification of their functionality on chosen positions;
- implementation of countermeasure on all relating work positions.

Workplaces can be sorted using process approach according their risks or can be grouped based on their similar risk and then focus on a particular workplace or group of workplaces.

Process approach can be used for classic safety also for health protection. It is suitable as a cost saving when the proposed countermeasure is first verified at selected workplaces and after positive feedback they can be applied on rest of position. Constant improvement is next benefit of process approach when real status and risk of each workplace

can be defined. It can be also verified if proposed countermeasures are effective and probability of work injury or occupational diseases decreased.

Prevention against work injury and occupational diseases

Process leading to goals achievement can be applied as prevention against work injury or occupational diseases. This statement can be proved by these ideas:

- Danger identification and risk assessment of concrete work places is basic step for prevention against work injury and also for occupational diseases (work categorization).
- Certain rules are valid for each system, therefore can be system characterised with word „law“ („nómia“ in Greek language) - interaction of subsystems (human, machine, work environment) happened by „work“ („érgo“ in Greek language). The word “Ergonomia” (ergonomics) comes with connection of two words „nómia“ and „érgo“. Ergonomics can be loosely translated as rules of work therefore ergonomics is general science which solves prevention against work injury and also occupational diseases.

Method of synergic effect

Technical and human principles can be identified in improvement process of implementation ergonomics into practice. Technical principle focuses on relationship between machine and work environment. Fig. 2 while human principle focuses on relationship between human - work environment and human - machine, Fig. 3.

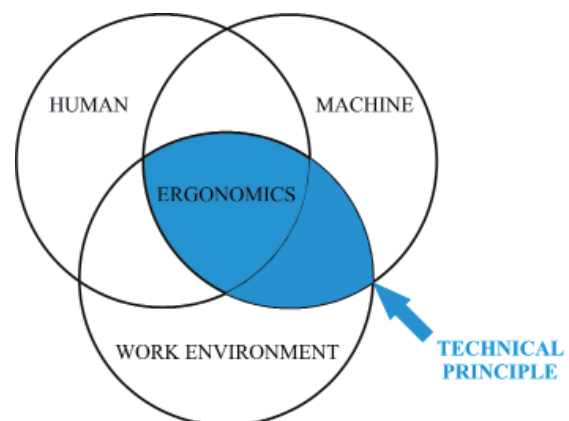


Fig. 2. Technical principle relationship

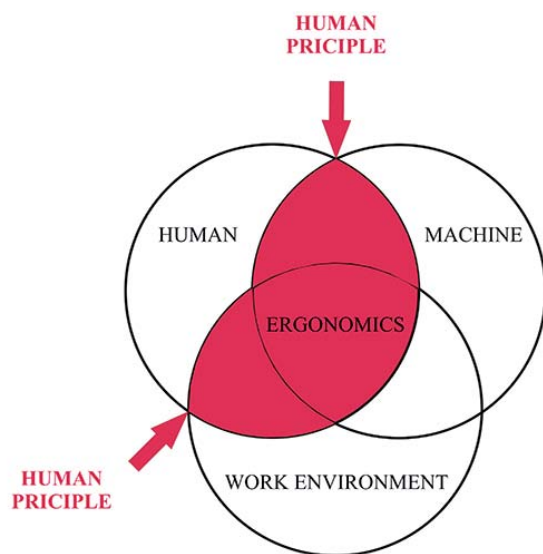


Fig. 3. Human principle relationship

Technical principle is rational thinking applied in virtue of defined technical possibilities and properties of machine or work conditions. Hazard identification and risk prevention are used for searching of potential problems focused on machine (e.g. rotate moving, hot surface and impulsive noise) or focused on work conditions (e.g. wet and slippery floor, unstable stack, high temperature).

Short, sudden and forced impact of above hazards can cause work injury. Technical principle is associated with work injury and does not take in consideration a human being as such.

Human principle is opposite to technical principle. It is focused on human. Hazard identification and risk prevention are used for searching of potential problems focused on human (e.g. local muscle drain, work position and psychical drain). Long term impact of above hazard results in occupational diseases. Human principle is associated with occupational diseases and takes a human being as such.

Tab. 1. shows comparisons of these principles are done for better understanding of their relationship into hazard identification and risk assessment.

Method of synergy effect application

Parallel view

Principles effect side by side and do not interact with each other but they follow same goal. Hazard and risk for concrete principle can be found if technical principle will focus on machine and work environment as prevention against work injury (rotation part, sharp edge, work at height) and human principle will focus only on human as prevention against occupational diseases (local muscle drain, work position, psychical drain).

Interacting view

Principles interact each other and they follow same goal. More hazard and risks can be found by interconnection of these principles. If technical principle will be extension of subsystem - human and human principle will be extension of subsystems - machine and work environment. Next benefit of this action is reaching of synergic effect - final result of hazard identification and risk assessment process will be more quality with better implementation into practice. Both of these principles are correct and lead to goal but interacting view has better efficiency and this better implementation into practice due to synergic effect, Fig. 4. Next text will be focused only on interacting view on basis of above information.

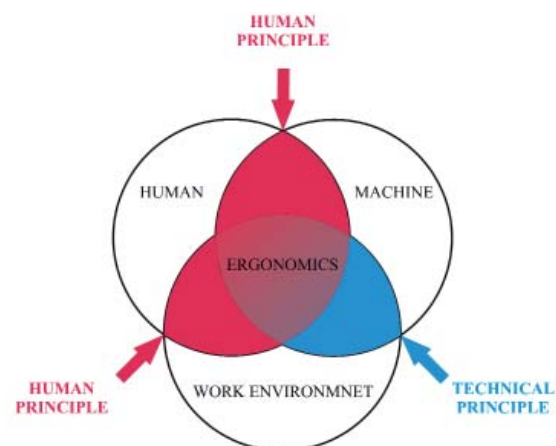


Fig. 4. Synergic effect

Tab. 1 Comparison of principles

Parameter	Technical principle	Human principle
Hazard	rotation part, sharp edge, work at height	local muscle drain, work position, psychical drain
Danger	work injury	work-related diseases
Impact	health damage	health damage
Time effect	short term	long term
Countermeasures	cover, LOTO, PPE, instruction	rotation, workplace design, mental health

Technical and human principles within legislation

According Directive 89/391/EEC from 12th of June 1989, employer shall:

- evaluate the risks to the safety and health of workers;
- take the measures necessary for the safety and health protection of workers.

Both principles can be identified (safety represents technical principle and health represents human principle) in text above. They are very tightly connecting with ergonomics. On basis of these ideas can be concluded that legislation focuses on prevention against work injury and occupational diseases as on ergonomics.

Decreasing of number of work injuries

Every employer has to check and assessment work injuries rating and setting up countermeasure and preventive actions to reach decreasing or at least non increasing trend of work injuries rating. Number of work injuries decreasing to value where further decreasing is not verified and approaching to limit of workplace though some technical and organization countermeasures were realized (application of technical principle) to decreasing of work injuries number (winding of rotate part, burns, slip, work at height, etc.).

Some changes of attitude to perception of occupational health and safety and founding of suitable conception to achieve decrease work injury

rate are inevitable. It should be looked on employee as one of basic subsystems and not to solve only technical or organization countermeasures - application of human principle.

Some questions focused on employee have to be applied, e.g. "Why employee did not use LOTO system, though he was equipped by it and he has special training?", "Why employee was not well ensured against fall down, though he had all necessary equipment and correct training?", "Why employee snapped fingers between body and door of car?", "Why employee stumbled over material lying on floor?".

Work psychology as one of basic science branch of ergonomics has to be applied for finding answers to these questions. Work psychology is theoretical and practical science, which solves how human psyche and personality manage work environment and which effect have work conditions and social relationship in work group on work efficiency (Kohoutek, 2018). This science represents important instrument for decreasing of work injuries. Implementation of work psychology into practice will be demonstrated on two samples.

Work psychology - risk factors

Production focused on assembly work with night shift prevails in Czech Republic. Employees are often affected by load created by psychosocial (monotony, force tempo, night shift, social and emotive factors, etc.) and / or psychological (employee characteristics, abilities, expectation, etc.) (Koutný and Hajduková, 2015). Tab. 2. shows samples of negative effect including countermeasures.

Tab. 2. Samples of negative effect + countermeasures

	Risk factor	Demonstration	Sample of countermeasure
Psychosocial	monotony	loss of attention; surrounding is not perceived; employee does not think about work;	suitable employee has to be chosen; rotation of activities; regular safety break;
	forced tempo	production is not met; panic; stress;	proper training on position; choosing of suitable employee; correct decomposition of drain;
	work at night	fatigue; loss of attention; worst quality of live;	sleep circadian rhythm (Duncan et al., 2014); family support;
	social and emotive	team relationships; the activities of superior employee; family;	creating a good mood at the workplace; positive motivation; setting up a fair procedure;
Psychological	willingness to adapt	inability to adapt to group work; failure to control production; risk behaviour; creating conflicting situations (Koutný and Hajduková, 2015);	multiphase employee selection; psychological testing of the employee focus on stress and load; proper training in position (Koutný and Hajduková, 2015);
	attention		
	reaction time		
	stress management		

Psycho hygiene

Countermeasure can be named as psycho hygiene. It is collection of preventive rules, which compliance helps mental and body health of employee. It is instrument for optimization of risk factors effects on employee and leads to increase of work efficiency and positive impact on employee psyche and endurance (Bender, 2015).

As sample can be mentioned positive motivation for concrete organized unit as a small gift for all employees (from this unit) by keeping number of days without work injuries. This system is supported by visualization - visible screening of this number in front of entrance into work. Number of work injuries within date of last injury is screened on light table.

Effect of social pressure is impacted by this programme. Employees check oncoming number of work injuries and they encourage each other to receive this goal. Employees feel bigger responsibility for collective success but there is some risk of negative pressure of unit to ignore small injuries.

Work unit fulfils one of its functions and creates space for sharing common goals and values. Individual interest in benefit for group is suppressed by acceptance of work without work injuries. This standard creates of relationships inside unit, influences and changes in group structures such as positions and roles. Successful employee is perceived as man who has no work injuries or is not on sickness leave. Individual behaviour in relation to injuries rate is changed and influenced by feeling of solidarity and unit acceptance.

Employees used to go with each light work injury to company doctor before implementing of this system. Number of these employees was dramatically decreasing after acceptance of lower injury rate. Work unit and its standard has sometimes negative role - undesirable conformity. Individual interest is suppressed for benefit of unit standard and social pressure. Individual who identified with unit often changes his behaviour according to unit standard. Light work injury may not be presented because unit and its attitude to individual would not agree (Radkovský and Koutný, 2016). Some individuals are willing to do things which are in breach with their morale only to live without complication (Mikuláščík, 2015). Employees have to pass some periodical training and also possibility of abuse of this system is mentioned.

Important countermeasure in range of psycho hygiene is also training on workplace. If employee is trained well, it is great premises that operation will be done easy and in time.

Basic condition is chosen of suitable trainer who will be executed trainer. Basic characteristic of trainer are:

- ability to properly explain and demonstrate the operation;
- ability to find mistakes and alert them accordingly;
- ability to hand over their own experience how to simplify and speed up individual operations;
- ability to solve interpersonal relationships and create optimistic mood in the workplace.

Employee will be work more effectively and quickly - create time for rest.

Second sample is choosing of suitable employee, which is basic pillar of psycho hygiene. If unsuitable type will be chosen, it will be suffering for him, his superior employee and co-workers.

Characteristic and abilities which are requested have to be set up on beginning. Second step is set up rules for interview. Basic characteristic are:

- willingness to adapt and comply with set rules;
- attention;
- reaction time;
- stress management.

Multistep interview is used to selection of employee with requested characteristics:

- interview lead by specialist from production;
- assessment of physical parameters;
- psycho and manual testss;
- correct medical check providing;
- training on workplace - check abilities on workplace (line);
- trial period - it is necessary recognize if employee keep tempo, manage load and adapt to production process (Koutný and Hajduková, 2015).

Result and discussion

Ergonomics is general science which solves prevention against work injury and also occupational diseases - it can be loosely translated as rules of work. This statement is verified by legislation. Process approach has to be implemented to reach goal of ergonomics - decreasing probability of work injuries or occupational disease. Technical and human principles can be identified in this process.

Human principle has to be implemented in case when number of work injuries decreasing to value where further decreasing is not verified though some technical and organization countermeasures were realized (technical principle is not sufficient) - interact view with synergic effect.

Work psychology as one of basic science branch of ergonomics was used for implementation of human principles into practice. It was demonstrated on two samples.

Psycho hygiene was used as instrument for optimization of risk factors effects on employee and leads to increase of work efficiency and positive impact on employee psyche and endurance.

Positive motivation for concrete organized unit as a small gift for all employees (from this unit) by keeping number of days without work injuries was used as second sample.

Conclusion

Ergonomics as science about work represents system in which some rules are valid and which includes subsystems (human-machine-work environment). These subsystems interact and complement each other. The goal of ergonomics can be reached by implementation of process where systematic approach is basis - focusing on ergonomics like on system in which subsystems are interacting and complementing each other.

Synergic effect (technical and human principles effect) was presented on samples from practice where their relation in prevention was shown.

Human principle brought changes of view and focusing on employee as source of work injuries. Space for work psychology implementation (psycho hygiene and positive motivation) was opened.

It is quite evident that synergic effect (linking technical and human principles) represents strong instrument for prevention against work injuries and occupational diseases.

Work psychology as prevention against work injury has not such an effect as elimination of risk direct by source (cover of rotation parts, installation of lifting barriers, work standard procedure, new tools usage, improvement design of workplace, set up manage station, etc.) Implementation of work psychology can be start when prevalence work injuries caused by mistake or failure of employee (pinch hand between body and door from car, bad snapping, trip about obstacle, sleep by driving of car, etc.).

In case of occupational diseases is situation different. It is clear that implementation of countermeasures on all workplaces in same time is not time consuming as implementation on single workplace. Manage rotation can be mentioned as sample of implementation on many position in same time (Koutný and Hajduková, 2015).

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